

(12) UK Patent Application (19) GB (11) 2 134 719 A

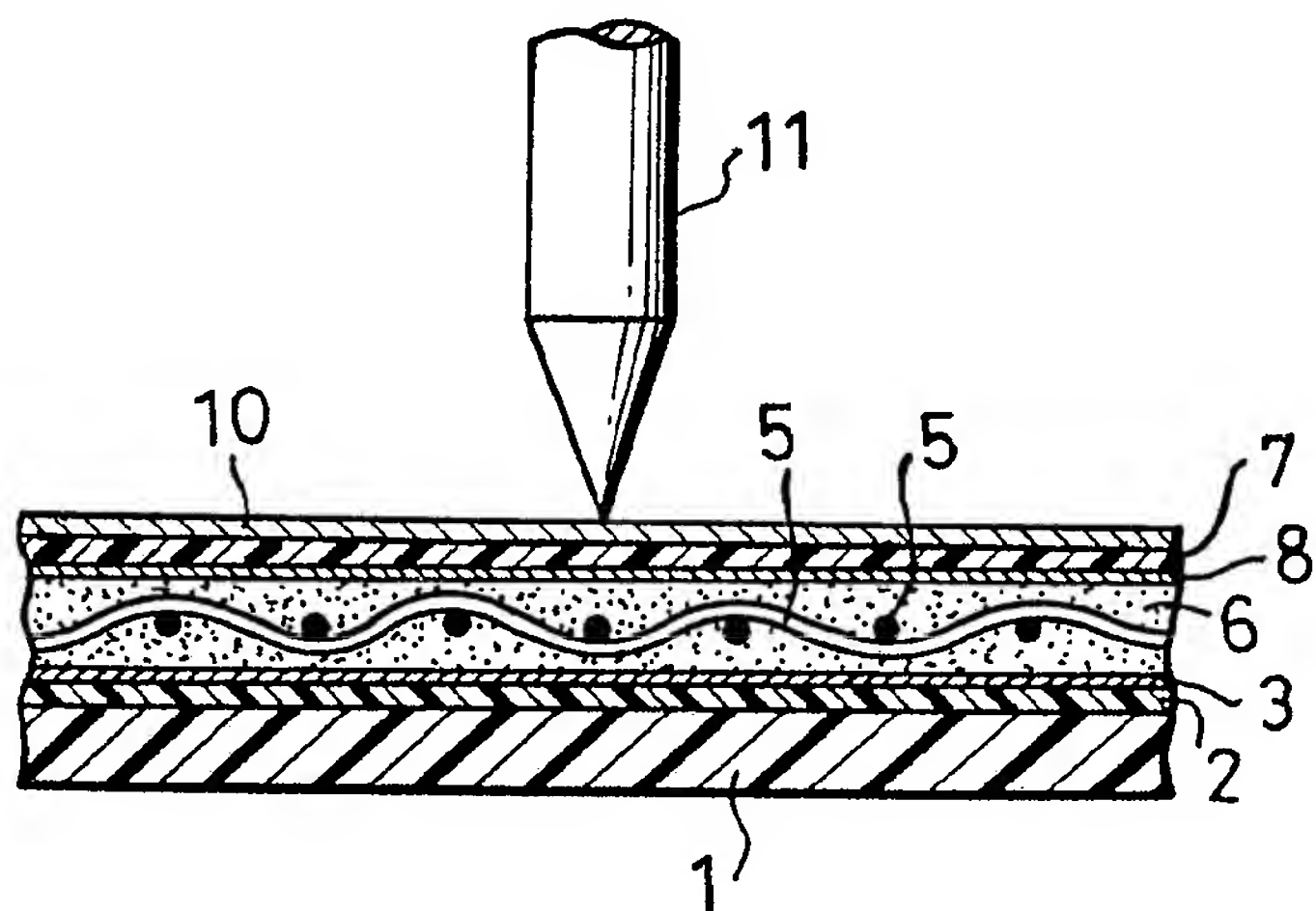
(21) Application No 8402441
(22) Date of filing 31 Jan 1984
(30) Priority data
(31) 58/012307
(32) 31 Jan 1983
(33) Japan (JP)
(43) Application published
15 Aug 1984
(51) INT CL³
G01L 1/20
(52) Domestic classification
H1S 9D1 BK
G1N 1A3B 1D8 3S10 7N 7S
AQA
U1S 2145 H1S
(56) Documents cited
GBA 2088063
GBA 2115556
GBA 2115555
(58) Field of search
H1S
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(54) Tactile sensor

(57) An input device for use in a display unit serving as a terminal of a computer has first and second insulating sheets 2, 7 and an insulating spacer 6 sandwiched between the first and second sheets. The first sheet has first terminal leads on its both ends, while the second sheet has second terminal leads which extend in perpendicular relation to the first terminal leads. The

upper surface is covered with a flexible, insulating, protective sheet. The spacer includes lattice-like conductors and consists of a material having cells of gas and elasticity and flexibility such as silicone foam. A fixed voltage is alternately applied across both ends of the first sheet and across both ends of the second sheet. When the protective sheet is depressed at a point P as by a depression pen, the position of the point is measured and represented by means of X- and Y-coordinates.

Fig.1



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Fig.1

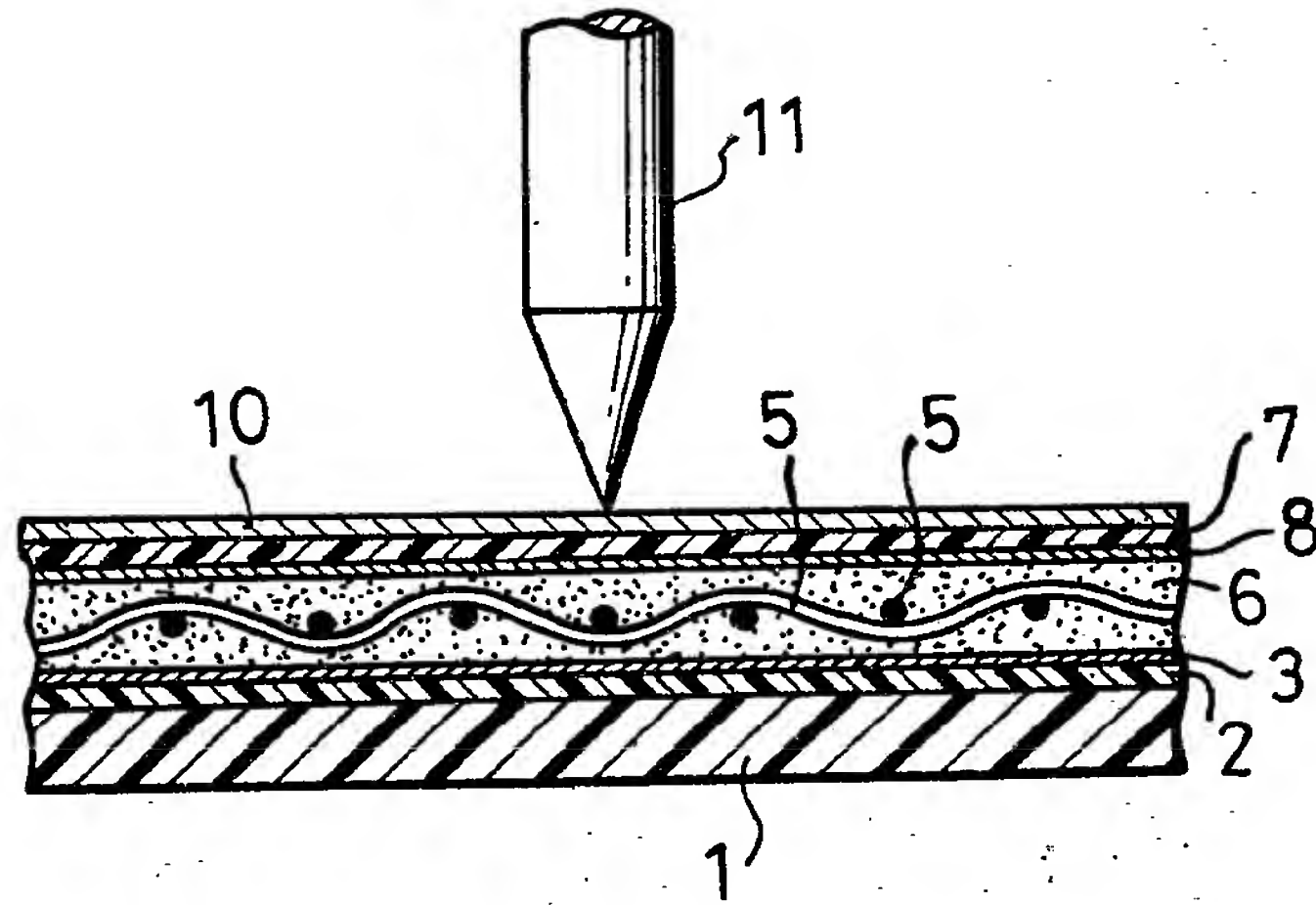


Fig.2(a)

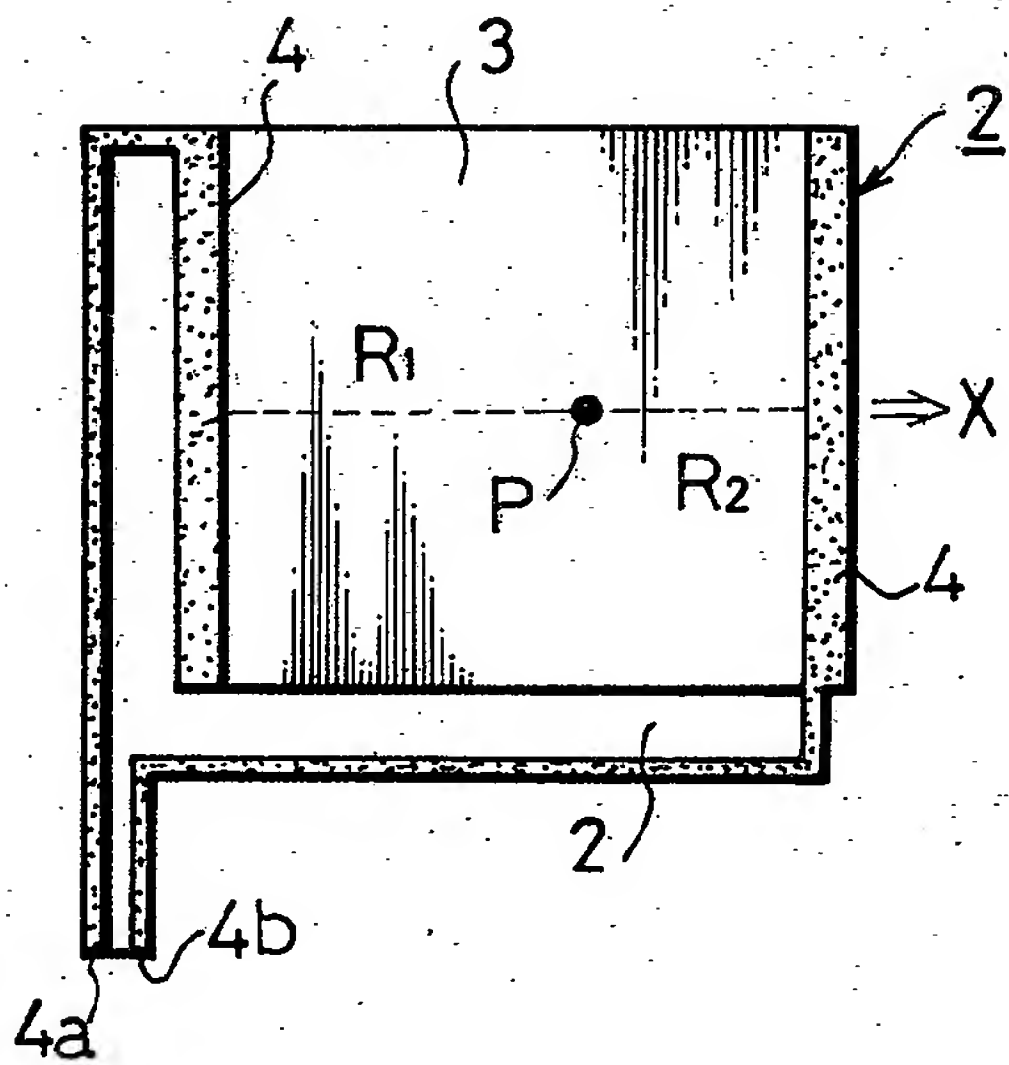
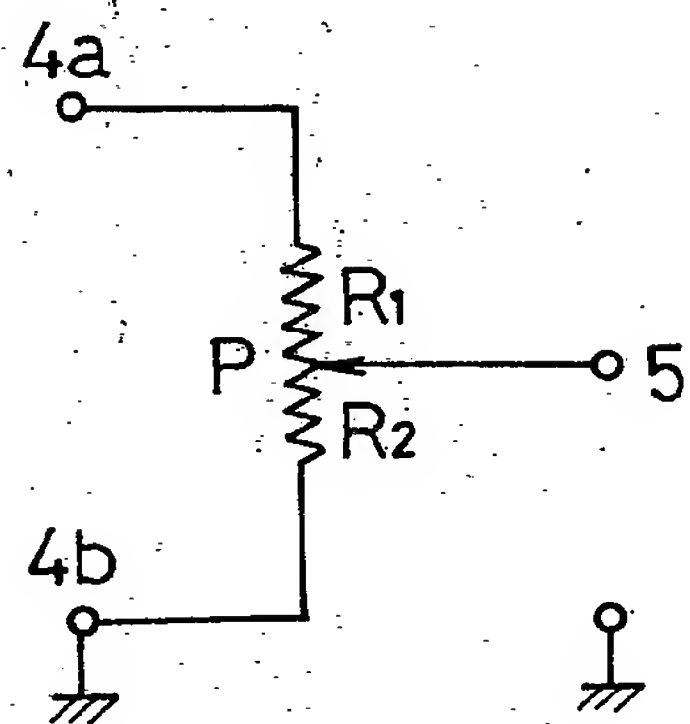


Fig.2(b)



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Fig.3(a)

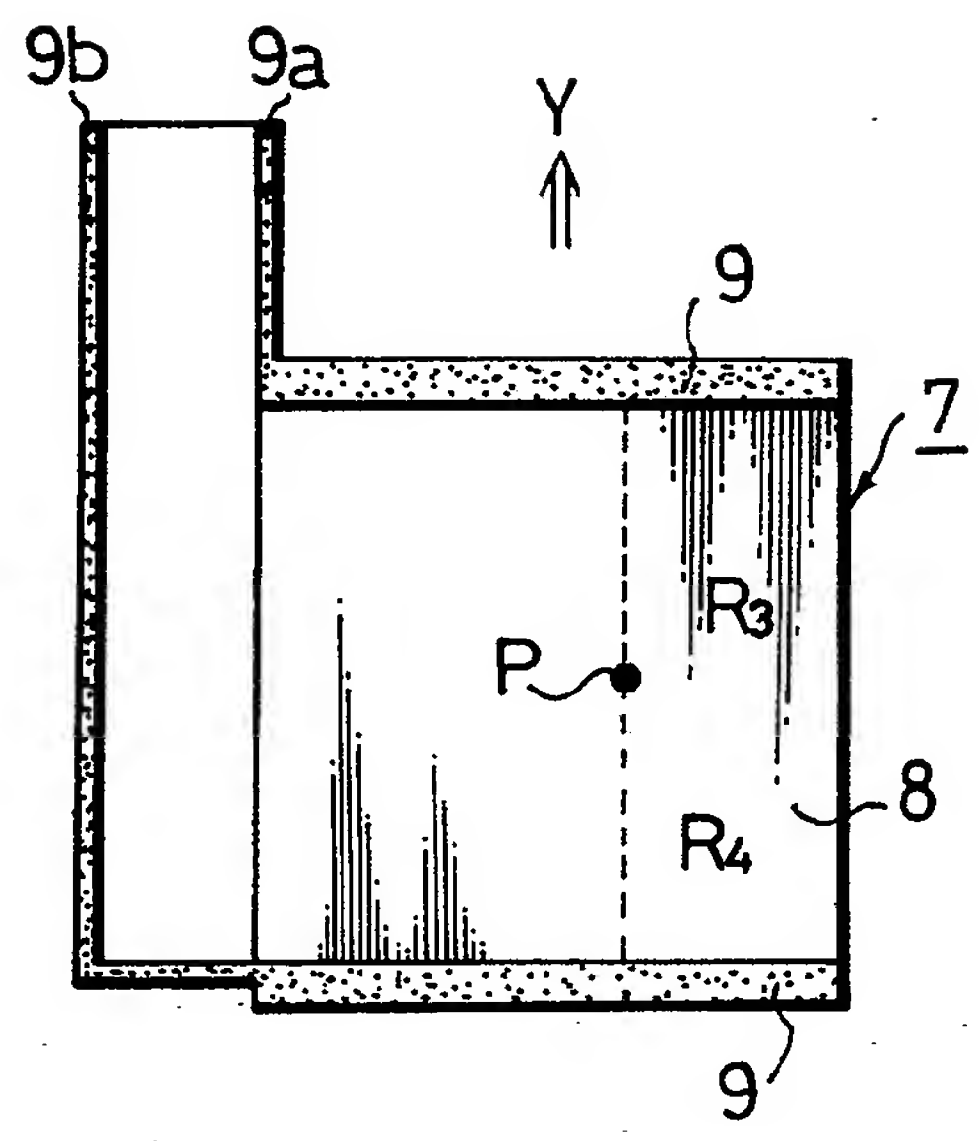


Fig.3(b)

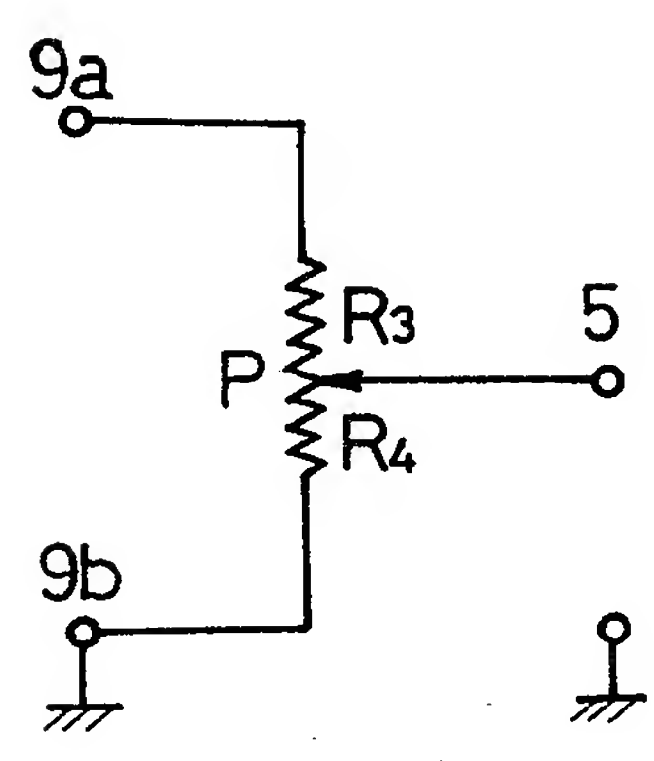
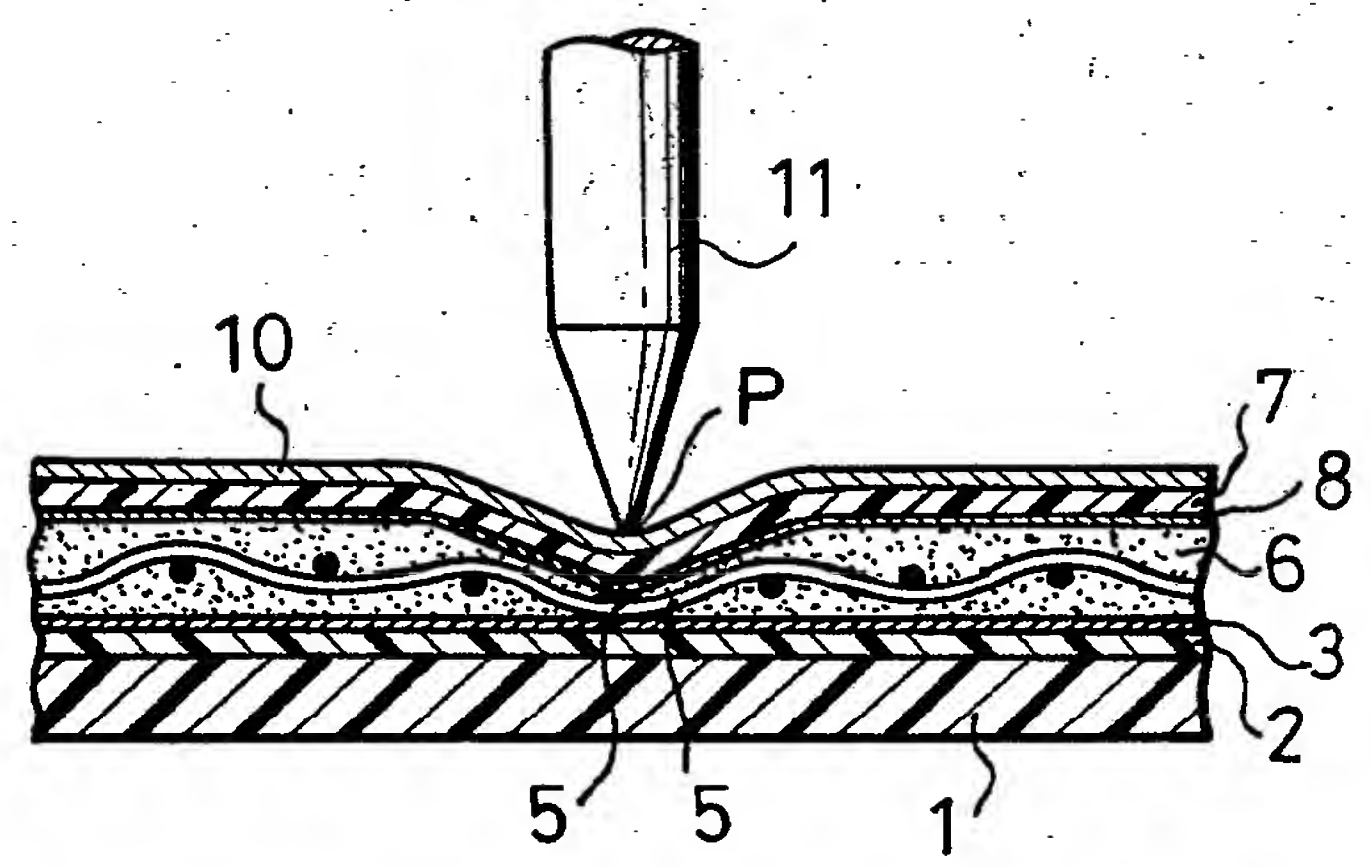


Fig.4



SPECIFICATION

Input device

FIELD OF THE INVENTION

The present invention relates to an input device
5 for use in a display unit such as a cathode-ray tube
serving as a terminal of a computer. More
specifically, the invention relates to a contact type
input device for detecting the position at which a
10 contact pen or the like is pressed on a panel
surface.

BACKGROUND OF THE INVENTION

Various devices of such a kind have been
heretofore proposed as, for example, electrode
contact type devices constituting a thin film
15 switch, optical matrix devices comprising a
combination of a light pen and a photodetector for
detecting coordinates of obstructions on optical
paths, pressure type devices for detecting the
pressure applied by a touch, and surface acoustic
20 wave devices for determining coordinates based
on propagation time taken by a surface acoustic
wave.

Among these devices, the electrode contact
type devices are simpler in structure and cheaper
25 than the other devices. However, coordinate input
devices of the conventional electrode contact type
structure tend to cause a higher contact resistance
and are mechanically fragile, because those
devices have been keyboard switches using a
30 transparent plastic film on which a thin sheet of a
metal, such as Ag and Pd, or a thin film of an oxide
metal, such as In_2O_3 , is formed over a given area
by evaporation or sputtering. Therefore, these
coordinate input devices have a poor yield and a
35 short life. In one of the aforementioned thin film
electrodes, fine powder of an electrically
conductive metal is dispersed in a synthetic resin.
However, the powder is not uniformly dispersed,
and an accurate detection of coordinates is not
40 possible. Further, a sufficient strength cannot be
obtained.

SUMMARY OF THE INVENTION

In view of the foregoing, it is the main object of
the present invention to provide an input device
45 which is simple in structure and less expensive to
fabricate, has a large mechanical strength, is
capable of accurately detecting coordinates, has
stable contact portions, and shows a strong
resistance to noise.

50 Other objects of the invention will appear in the
course of the description thereof which follows.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cross-sectional view of an input
device according to the present invention;

55 Fig. 2 (a) is a plan view of the device of Fig. 1
for showing the first insulating sheet, resistor layer
and terminal leads of the device;

Fig. 2 (b) is a wiring diagram of the components
shown in Fig. 2 (a);

60 Fig. 3 (a) is a plan view of the device of Fig. 1
for showing the second insulating sheet, resistor

layer and terminal leads of the device;

Fig. 3 (b) is a wiring diagram of the components
shown in Fig. 3 (a); and

65 Fig. 4 is a cross-sectional view of the input
device of Fig. 1 when it is put into work.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings, there is shown an
input device of a two-axis display unit for
determining coordinates represented in terms of
70 X- and Y-axes, in accordance with the present
invention. The device has a base plate 1 on which a
substantially square insulating sheet 2 is placed. A
resistor layer 3 consisting of an electrically
75 conductive paint to which carbon or other
conductive material is appropriately added is
uniformly formed on the insulating sheet 2. At the
ends of the resistor layer 3 in the X-axis direction,
terminal leads 4 are formed as can be seen from
80 the plan view of the layer 3 of Fig. 2 (a). The
terminal leads 4 are thin film electrodes made of
Ag or other conductive metal material and formed
on the resistor layer 3. As shown, the terminal
leads extend out from end portions 4a and 4b,
85 across which a fixed voltage is applied.

Placed on this first resistor layer 3 is an
insulating spacer 6 in which a conductor 5 braided
like a lattice is imbedded. The conductor 5
consists of a mesh braided out of thin wires of a
90 conductive material such as copper or bronze
which is plated with gold or coated with carbon
paint of a low resistance. The diameter of the
wires is of the order of 0.05-0.2 mm, and these
wires are arranged parallel. The aforementioned
95 spacer 6 consists of a material having cells of
gas and possessing elasticity and flexibility as, for
example, silicone foam. When the spacer is not
depressed, it holds the conductor 5 in it and
insulates the conductor at the upper and lower
100 surfaces thereof. When it is depressed, the spacer
deforms and easily lays the conductor 5 bare at
the upper and lower surfaces. Both ends of the
conductor 5, that is, the ends of the thin wires of
the mesh, extend out from the side end surfaces of
105 the insulating spacer 6 and are electrically
connected to one end of a circuit containing the
resistor layer 3.

A second insulating sheet 7 is placed on the
insulating spacer 6. As shown in Fig. 3(a), a
110 second resistor layer 8 is formed on the underside
of the second sheet 7 in the same manner as the
first resistor layer 3. The second resistor layer 8 is
similar in shape and material to the first resistor
layer 3 and has terminal leads 9 at both ends
115 thereof. However, the leads 9 extend in the
direction of the Y-axis, that is, in perpendicular
relation to the first terminal leads 4. The given
voltage is applied across end portions 9a and 9b
independently of the first resistor layer 3. The
120 conductor 5 extending out from the side end
surfaces of the spacer 6 has one end electrically
connected with a circuit including the resistor
layer 8. The upper surface of the second insulating
sheet 8 is coated with a flexible, insulating,
125 protective sheet 10 made of polyurethane.

In the input device constructed as described above, the given voltage is applied across the end portions 4a and 4b of the terminal leads 4 along the X-axis and across the end portions 9a and 9b of the terminal leads 9 along the Y-axis, as described previously. More specifically, the fixed voltage is alternately applied to the terminal leads 4 and 9, so that signals may be detected one after another for the X- and Y-axis directions.

In the operation of the novel input device, when the insulating, protective sheet 10 is depressed by a tapering depression member 11 at a point P, as shown in Fig. 4, the conductor 5 is depressed via the sheet 10, the second insulating sheet 7 and the insulating spacer 6. Then, the spacer 6 above and below the conductor 5 is somewhat pushed aside and made thinner to a great extent. Hence, the conductor 5 comes into contact with the first and second resistors 3 and 8, respectively, and there occurs a short circuit. Accordingly, the electric potential at the point of depression P is detected in the X-axis and Y-axis directions through the conductor 5, while the voltage is alternatively applied to the first layer 3 and the second layer 8. Thus, the point P is determined by means of X- and Y-coordinates.

More specifically, it is assumed that the resistances to the point P as viewed from the sides of the input end portions 4a and 4b when the given voltage is applied across these end portions are R_1 and R_2 , respectively. The position of the point P on the X-axis when the point P on the resistor layer 3 formed on the insulating sheet 2 as shown in Fig. 2 (a) is depressed is determined by the ratio of the resistance R_1 to the resistance R_2 corresponding to the position of the point P as shown in Fig. 2 (b), the ratio being measured by the voltage taken from the conductor 5. In exactly the same manner, it is assumed that the resistances to the point P as viewed from the sides of the input end portions 9a and 9b as viewed from the sides of the input end portions 9a and 9b are R_3 and R_4 , respectively, as shown in Fig. 3 (a). The position of the point P on the Y-axis when the point P on the second insulating sheet 7 is depressed is determined by the ratio of the resistance R_3 to the resistance R_4 corresponding to the position of the point P as shown in Fig. 2 (b), the ratio being measured by the voltage taken from the conductor 5.

In the illustrative embodiment, the metal mesh braided like a lattice is used as the conductor 5, and therefore even if the input device is quite thin, a certain strength is given to the conductor. Further, even if the resilience of the insulating spacer is small, the conductor can deform while sufficiently held in the spacer. The open space between the strands of the mesh may be appropriately dimensioned according to a desired specific application.

It is also to be understood that the conductor 5 is not limited to a mesh, but rather a thin film, a number of strip members or any other material

may be used instead, provided that they satisfy the requirements including the mechanical strength, weight and conductivity. Furthermore, although the second insulating sheet 7 is formed independently of the insulating protective sheet 10, both may be joined together as by fusing the surface of the sheet 7 and then hardening it.

As hereinbefore described, in the novel device, both ends of the conductor 5 imbedded in the insulating spacer 6 is electrically connected with the one end of the circuit including the first resistor layer 3 and also with the one end of the circuit including the second resistor layer 8. Consequently, the contact of each of the resistor layers 3 and 8 with the conductor 5 only at one location permits direct detection of the electric potential in the X- and Y-axis directions through the conductor 5. In this way, the portion which makes contact for electric conduction can be only one conductor consisting of the resistor and metal. Thus, the novel structure is much less affected by noise than a structure making use of contact between first and second resistor layers. As a result, a quite accurate determination of coordinates is made possible.

CLAIMS

1. An input device comprising:
 - a first insulating sheet on which a first resistor layer is formed, both ends of the sheet having terminal leads,
 - a second insulating sheet on which a second resistor layer is formed, the second sheet having second terminal leads which are formed so as to extend in perpendicular relation to the first terminal leads, and
 - an insulating and elastic spacer in which a conductive body is imbedded, the spacer being sandwiched between the first and second insulating sheets,
 - and wherein the electric potentials at the positions where the first and second resistor layers make contact with the conductive body, respectively, are detected through the conductive body when the second insulating sheet is depressed.
2. An input device as set forth in claim 1, wherein said conductive body consists of lattice-like conductors.
3. An input device as set forth in claim 2, wherein said lattice-like conductors are formed by braiding thin metal wires into a lattice-like configuration.
4. An input device as set forth in claim 3, wherein said thin metal wires are plated with a noble metal having a good conductivity or coated with a carbon paint of a low resistance.
5. An input device as set forth in claim 1, wherein said conductive body is made of one thin film conductor.
6. An input device as set forth in claim 1, wherein said conductive body is a combination of a number of conductive strip members.

7. An input device as set forth in claim 1,
wherein said insulating spacer is made of silicone
foam.

8. An input device substantially as hereinbefore
5 described with reference to the accompanying
drawings.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1984. Published by the Patent Office,
25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.